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| 09/749,473 | 12/28/2000 | Hiroyuki Ikeda | 201376US2 | 6320 |
| 22850 | 7590 | 02/20/2004 | EXAMINER | |
| OBLON, SPIVAK, MCCLELLAND, MAIER & NEUSTADT, P.C. 1940 DUKE STREET ALEXANDRIA, VA 22314 | | | UHLIR, NIKOLAS J | |
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| | | | 1773 | |

DATE MAILED: 02/20/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/749,473

Applicant(s)

IKEDA, HIROYUKI 

Examiner

Nikolas J. Uhler

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 12 January 2004.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1 and 3-14 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1 and 3-14 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

1. This office action is in response to the amendment/arguments dated 1/12/04. Currently, claims 1 and 3-14 are pending.

Withdrawal of Prior Grounds of Rejection

2. The applicant's amendment to the instant claims is sufficient to overcome the previous grounds of rejection. Accordingly, the previous grounds of rejection are withdrawn. However, the applicant's amendment/arguments are not sufficient to overcome the new grounds of rejection set forth below.

Claim Rejections - 35 USC § 103

3. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.
4. Claims 1-7 and 9-13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sugita et al. (US4687712) in view of Hokkyo et al. (US6387483), and Michaelsen et al. (US4245008).
5. Claim 1 requires a magnetic recording medium comprising a non-magnetic substrate, at least two soft magnetic layers divided by a separate layer there between, each of said at least two soft magnetic layers having a thickness that prevents a non-uniformity of a crystal structure; and at least one magnetic layer formed on the substrate via the at least two soft magnetic layers, wherein the surface roughness Ra of the medium is at most 50 angstroms, and the product $\mu_{\max} \cdot t$ of the maximum permeability (μ_{\max}) and the thickness (t) is at least 1,500,000 H*a/m.

6. With respect to these limitations, Sugita et al. teaches a vertical (perpendicular) magnetic recording medium comprising a substrate that has been coated with alternating layers of permalloy and a non-magnetic layer, wherein a vertical magnetic recording medium is deposited on the outermost permalloy layer (column 2, line 65-column 3, line 10). It is well known in the art that Permalloy is a soft magnetic material. Further, Sugita et al. specifically teaches an example wherein polymer substrate is coated with a 4 layers of permalloy wherein a 100 angstrom thick Ti non-magnetic spacer layer is present between any two permalloy layers, and a 1500 angstrom thick CoCr perpendicular magnetic layer is on the uppermost permalloy layer (see figure 3 and column 2, lines 1-35). Though Sugita does not specifically teach the thickness of the permalloy layers in this example, Sugita teaches that the permalloy layers are preferably 1200 angstroms thick or less (see column 3, lines 14-17).

7. Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made to form the Permalloy layers taught by Sugita in the embodiment shown by figure 4 to a thickness of 1200 angstroms.

8. One of ordinary skill in the art would have been motivated to make this modification for two reasons. First, Sugita explicitly states that the Permalloy layers are preferably 1200 angstroms or less. Second, in figure 4, Sugita demonstrates the impact of total Permalloy thickness on the reproduction output of the perpendicular media when 4 layers of Permalloy are utilized (see figure 4, line labeled 10). As can be clearly seen, the reproduction output of this structure peaks when the Permalloy thickness is between 4000-6000 angstroms. Thus, one of ordinary skill in the art would be motivated to utilize

1200 angstrom thick layers of permalloy in the embodiment shown by figure 3, as this would result in 4800 angstroms of permalloy being used, which as shown in figure 4 made would maximize reproduction output of the structure.

9. Regarding the requirement in claim 1 that the soft magnetic layers have a thickness that prevents non-uniformity of crystal structure. The applicant on page 9, line 21-page 10 line 4 of the instant specification discloses that the thickness of the soft magnetic layer impacts the uniformity of the crystal structure of the soft magnetic layer, with non-uniformity of crystal grains increasing with thickness of the soft magnetic layer, and that this property is manifested by an increase in surface roughness. Further, the applicant discloses on page 13, lines 10-25 of the instant specification that the thickness of the soft magnetic layers is preferably no greater than 4000 angstroms, more preferably no greater than 1500 angstroms, and preferably greater than 100 angstroms, more preferably greater than 300 angstroms. The applicant states that if the soft magnetic layer is too thick, the roughness increases, and if the soft magnetic layer is too thin, adequate yoke effect cannot be obtained. Thus, the examiner takes the position that the specific example cited above meets the applicants claimed "thickness that prevents non-uniformity of crystal grains" as the this example utilizes multiple 1200 angstrom permalloy layers, and 1200 angstroms falls completely within the optimum thickness range (300-1500 angstroms) cited in the instant specification as being suitable for use.

10. Regarding the $\mu_{max} \cdot t$ requirement of claim 1. It is noted that Permalloy is well known in the art to be comprised of various NiFe alloys. The applicant admits on page

11 of the specification that NiFe alloys have a μ_{\max} of $\sim 330 \text{ H/m}$. It is the examiners position that the Permalloy alloy utilized by Sugita will exhibit a μ_{\max} of at least this value. Thus, for the example above wherein 4800 angstroms of Permalloy employed, the soft magnetic material will exhibit a $\mu_{\max} \cdot t$ of $1536000 \text{ H} \cdot \text{\AA}/\text{m}$. Thus, this limitation in claim 1 is met.

11. However, Sugita does not teach a magnetic recording medium wherein the medium has a surface roughness R_a of < 50 angstroms, as required by claim 1.

12. With respect to this deficiency, Hokkyo et al. teaches a perpendicular magnetic media that comprises a substrate that has been coated with a thin smoothness control layer, wherein the smoothness control layer is further coated with a soft magnetic layer and the soft magnetic layer is coated with a perpendicular magnetic recording layer (column 2, lines 8-14). Hokkyo states that in perpendicular magnetic recording media, poor surface smoothness of the soft magnetic layer degrades the perpendicular orientation of the perpendicular magnetic layer formed on the soft magnetic layer (column 1, lines 60-67). Hokkyo teaches that adding a smoothness control layer that possesses excellent surface smoothness results in subsequent layers formed on top of the smoothness control layer also exhibiting improved smoothness (column 2, lines 15-25). Magnetic media with improved surface smoothness exhibit higher recording density, lowered noise, and improved read output voltage (column 2, lines 23-25).

13. Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made to add a smoothness control layer as taught by Hokkyo between the substrate and the first soft magnetic layer taught by Sugita et al.

14. One would have been motivated to make this modification due to the teaching in Hokkyo that the smoothness of a magnetic recording medium can be improved through the addition of a smoothness controlling layer between the substrate and a soft magnetic layer in a magnetic recording medium, and that improving the smoothness of the media results in improved recording density, noise, and read output voltage.

15. Further, referring to figures 7 and 8 of Hokkyo, it is clearly shown that the smoothness control layer improves the roughness of the soft magnetic layer, and that there is a strong correlation between the roughness of the magnetic recording layer and the roughness of the soft magnetic underlayer film. Thus, as the smoothness control layer serves to improve the surface roughness of the soft magnetic layer, it necessarily improves the smoothness of the magnetic recording layer (column 10, lines 34-47).

16. More specifically, as the roughness of the smoothness control layer increases, the roughness of subsequent layers increases, whereas if the roughness of the smoothness control layer decreases, the smoothness of subsequent layers also decreases. Thus, the examiner takes the position that the smoothness of the magnetic smoothness control layer is a results effective variable, and it would have been obvious to one of ordinary skill in the art to optimize the smoothness control layer to be as smooth as possible in order to obtain a magnetic recording layer that is as smooth as possible.

17. Regarding claim 3, wherein the applicant requires the recording medium to have between 2-20 soft magnetic layers, with a separate layer between adjacent soft magnetic layers. This limitation is met as set forth above for claim 1.

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18. Regarding claim 4, wherein the applicant requires to total thickness of the soft magnetic layers and the separate layers to be in the range of 500-10,000 angstroms. The example cited above for claim 1 specifically utilizes four 1200-angstrom Permalloy layers separated by three 100-angstrom Ti spacer layers. This results in the total stack having a thickness of 5100 angstroms. Thus, the limitations of claim 4 are met.

19. Regarding claims 5 and 6, wherein the applicant requires the ratio of the thickness of the soft magnetic layers to the thickness of the separator layers to be in the range of 1:0.05-1:0.5, more specifically 1:0.07-1:0.2. The limitations of claim 5 are met as stated above, as the ratio of total Permalloy thickness/total separator thickness for the cited example is 1/0.0625 (4800/300).

20. Regarding the limitations of claim 6, it is noted that Sugita teaches other examples wherein 150-angstrom thick Ti layers are utilized to separate adjacent Permalloy layers (see column 6, embodiment 4).

21. Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made to utilize 150-angstrom Ti layers to separate adjacent Permalloy layers in the structure taught by Sugita.

One would have been motivated to make this modification in lieu of the fact that Sugita specifically teaches that 150-angstrom thick Ti layers are suitable for separating adjacent Permalloy layers. Further, the examiner also takes the position that as Sugita explicitly lists both 150 angstrom and 100-angstrom thick Ti layers as suitable for use as separator layers between adjacent Permalloy layers, the prior art recognizes their equivalency.

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22. The applicant is respectfully reminded that substitution of equivalents requires no express motivation as long as the prior art recognizes the equivalency. *In Re Fount* 213 USPQ 532 (CCPA 1982); *In Re Siebentritt* 152 USPQ 618 (CCPA 1967); *Grover Tank & Mfg. Co. Inc V. Linde Air Products Co.* 85 USPQ 328 (USSC 1950).

23. Thus, when three 150-angstrom thick Ti layers are utilized to separate the four 1200-angstrom layers of Permalloy in the embodiment shown by figure 3, the limitations of claim 6 are met as stated above as the ratio of total Permalloy thickness/total separator thickness for the cited example is 1/.09375 (4800/450).

24. Regarding claim 7, wherein the applicant requires the separate layers to be non magnetic. This limitation is met by the example stated above for claim 1, which utilize Ti (a known non magnetic) as the material for the separator layers.

25. Regarding claim 9, wherein the applicant requires the thickness of the separator layers to be in the range of 50-300 angstroms, this limitation is met as set forth above.

26. Regarding claim 10, wherein the applicant requires the maximum permeability of the soft magnetic material is in the range of 10-1,000,000 H/m. this limitation is met as set forth above for claim 1.

27. Regarding claim 11, wherein the applicant requires the soft magnetic to have coercivity ≤ 100 oersted. This limitation is met by the example stated above for claim 1, which utilizes Permalloy as the soft magnetic material. Permalloy is known in the art to have a coercivity below 50 oersted, as shown by Michaelson (column 2, lines 65-68).

28. Regarding claim 12, wherein the applicant requires, the soft magnetic layer to be made of NiFeMo or NiFe alloy. This limitation is met as set forth above for claim 1, as Permalloy is a known NiFe alloy.

29. Regarding claim 13, wherein the applicant requires the medium to be a perpendicular recording medium. This limitation is met as set forth above for claim 1.

30. Claim 8 is rejected under 35 U.S.C. 103(a) as being unpatentable over Sugita et al. as modified by Hokkyo et al. and Michaelson as applied to claims 1-7, and 9-13 above, and further in view of Lal et al. (US5834111).

31. Sugita et al. as modified by Hokkyo et al. and Michaelson does not teach a magnetic recording medium that comprise a substrate that has been coated with a plurality of alternating layers of a soft magnetic layer and a separation layer, wherein the separation layer comprises chromium or an alloy containing chromium as the main component, as required by claim 8.

32. However, Lal et al. teaches a magnetic recording medium comprising a substrate, a chromium underlayer formed on the substrate, a multilayer magnetic film comprising 1st and 2nd magnetic layers formed on the chromium underlayer, an isolation layer between the first and second magnetic layers, and a wear resistant over coat (column 1, lines 62-67). The non-magnetic isolation layer is manufactured from one of chromium, titanium, molybdenum, zirconium aluminum, etc.... (Column 4, lines 8-15)

33. Therefore it would have been obvious to one of ordinary skill in art at the time the invention was made to substitute chromium for titanium as the spacer layers in the

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multilayer magnetic media taught by Sugita et al. as modified by Hokkyo et al. and Michaelson

34. One would have been motivated to make this modification due to the teaching in Lal et al. that titanium and chromium are equivalent materials for use as a spacer layer between two magnetic layers.

35. Claim 14 is rejected under 35 U.S.C. 103(a) as being unpatentable over Sugita et al. as modified by Hokkyo et al. and Michaelson as applied to claims 1-7, and 9-13 above, and further in view of Kanbe et al. (US6221508).

36. Sugita et al. as modified by Hokkyo et al. and Michaelson does not teach a magnetic recording apparatus comprising a magnetic recording medium, a driving means to drive the magnetic recording medium in a recording direction, a magnetic head provided with a recording section and a reproducing section, a means to relatively move the magnetic head against the magnetic recording medium, and a recording/reproducing signal treating means to input recording signals to the magnetic head and to output reproducing signals from the magnetic head, wherein the magnetic recording medium is a magnetic recording medium as defined in claim 1, as required by claim 14.

37. However, Kanbe et al. teaches a magnetic storage apparatus that comprises a magnetic head assembly, a head drive unit, a processor unit for processing recording and playback signals from the head, a magnetic medium, and a drive unit for rotation of the magnetic medium (column 6, lines 20-32). The magnetic head comprises a recording and a reading element (column 6, lines 35-37). The magnetic medium is a

multilayer magnetic media comprising a substrate, 1 or more underlayers, a recording layer, and a protective layer (column 7, lines 24-49).

38. Therefore it would have been obvious to one with ordinary skill in the art to utilize the magnetic recording medium described by Sugita et al. as modified by Hokkyo et al. and Michaelson in the magnetic recording apparatus described by Kanbe et al.

39. One would have been motivated to utilize the recording media of Sugita et al. as modified by Hokkyo and Michaelson in a recording apparatus such as that described by Kanbe et al. due to the teaching in Kanbe et al. that such an apparatus is suitable for reading and recording magnetic media that comprises at the most basic level a substrate, one or more underlayers, and recording layer, and the teachings in Sugita et al. as modified by Hokkyo et al. of a magnetic recording media that comprises a substrate, multiple underlayers, and a recording layer.

Response to Arguments

40. Applicant's arguments filed 1/12/2004 have been fully considered but they are not persuasive. The crux of the applicants argument is that the cited prior art does not teach the amended Mr*T value. The new grounds of rejection set forth above have rendered this argument moot.

Conclusion

41. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Nikolas J. Uhler whose telephone number is 571-272-1517. The examiner can normally be reached on Mon-Fri 7:30 am - 5 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Paul J. Thibodeau can be reached on 571-272-1516. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



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